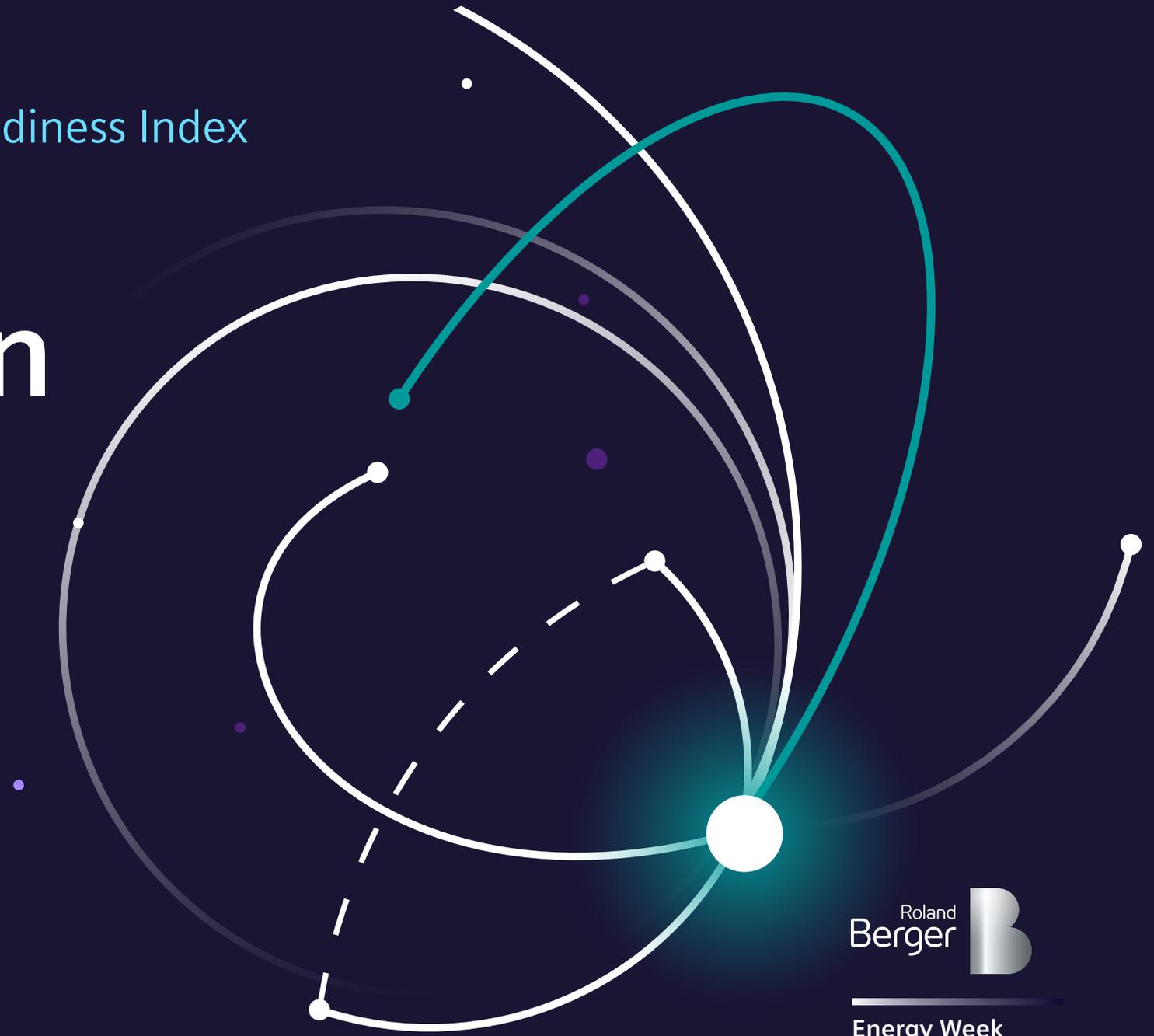


Middle East and Africa Energy Transition Readiness Index

# Green hydrogen for the world

The Middle East and Africa are likely to become an epicenter of sustainable energy – but increased regulation and targeted investment are crucial

**SIEMENS**  
ENERGY



Roland  
Berger 

Energy Week  
Knowledge  
Partner

# Energy transition: It's time for immediate action

The Middle East and Africa Energy Week highlighted that the region is well positioned to become a major supplier of sustainable energy to global markets. However, the area requires stabilizing regulations, significant investments and a substantial increase in collaboration to realize this potential.

A seismic shift is transforming traditional energy structures across the globe, redefining what it means to create a sustainable world. The Energy Week conferences, a series of events each focusing on a different geographical region, hosted by Siemens Energy and partners, bring together industry, political and society leaders from around the world to tackle the increasingly serious challenges that face not only the energy industry but society at large.

Participants in the conference were asked about the importance of a range of key energy priorities that together form a complete framework for a successful energy transition.

They were also asked what progress they believe had been achieved so far on each of the priorities.

Our investigation found that the Middle East and Africa have the necessary broad access to low-cost renewable energy in order to become producers of sustainable green energy. However, the region requires major capital investments, which in turn rely on clear policy frameworks being in place. Equally critical is increased collaboration along the entire value chain – from green hydrogen developers and financial institutions to suppliers – and between governments.

“We need to act, and we need to act quickly.

H. E. Suhail Al Mazrouei,  
Minister of Energy & Infrastructure  
United Arab Emirates

“Everyone gets it and has the same ambition, but we have an implementation problem, not an identification problem.

Christian Bruch,  
President and CEO,  
Siemens Energy

# Key insights

The Middle East and Africa Energy Week cast an important light on the region's prospects with regard to the energy transition. The discussions drew attention to five key insights, factors that are critical for the future growth of the region:

- **Green hydrogen is key:** Countries throughout the region are at different stages of the energy transition. However, one thing is already clear: Exporting green hydrogen to the European demand center presents a major economic prospect and the opportunity to gain geo-political significance in the global decarbonization effort. Speed is key to establish and reinforce long-term supply chains. Hence, speeding up the development of renewable energy will be a priority for all countries wishing to enter the green hydrogen game
- **The energy transition can solve the energy trilemma in Africa:** The African continent enjoys a significant economic opportunity in the shape of sustainable, decentralized energy applications, bespoke financing options and intercontinental collaboration
- **The current challenging energy situation in Europe can be a catalyst for the region:** Just a few months ago, green hydrogen was not considered economically viable. Now things have changed, as gas supplies for Europe become increasingly scarce
- **Greater funding support is needed throughout the region:** Access to financing is a prerequisite for decarbonization efforts. Financial instruments need to be tailored to the specific nature of countries in the Middle East and Africa
- **Regulatory frameworks must be enhanced:** A stable regulatory environment is vital for enabling more funding and long-term investment

Debate at the Energy Week focused in particular on the first three of these insights. Conference participants believed that green hydrogen and its derivatives are where the future likely lies for the region's energy exports. Demand for hydrogen in Europe is forecast to grow from its current level of 10 million tons a year to 20 million tons by 2030, and 95 million tons by 2050. Around half of this demand will be met by imports.

The consensus at the conference was that a large portion of these imports will originate in the Middle East and Africa. The region is busy expanding its production capacity accordingly, with lighthouse projects for example in Saudi Arabia and Namibia. Gigawatt-scale projects are anticipated to come online as soon as 2025.

Discussions about energy in Africa have often focused in recent decades on the "energy trilemma" – the need to find the right balance between affordability, reliability and sustainability. Of these three factors, access to energy remains perhaps the most critical one for Africa. The disparity between different countries in Africa means that tailor-made solutions are called for, from bespoke financing options and decentralized energy applications to intercontinental collaboration on transmission grids.

The energy transition represents a significant economic opportunity for the African continent. However, the benefits must be distributed throughout society. Educating and upskilling of the population can form a basis for this, enabling broad participation in the economic opportunity. The energy transition is a unique opportunity to drive broad socio-economic development. A just transition sees associated cost shared in a manner that places no additional burden on economic development. This economic development needs to translate into employment and development opportunities throughout the entire population. Specific needs of each country must be considered in order to fully tap the societal potential and ensure no one is left behind.

“The Middle East can play a key role in addressing the new priorities of Europe's energy transition

Pierre Samaties,  
Partner – Roland Berger

“We must remember that every ton of CO<sub>2</sub> we emit into atmosphere will need to be removed

Dietmar Siersdorfer,  
Managing Director Middle East,  
Siemens Energy

## The Energy Transition Readiness Index

During the conference, participants (experts and decision-makers from the entire energy sector in the Middle East and Africa) completed a survey related to each session's focus. Up to 400 session participants completed the survey. The Energy Transition Readiness Index is calculated based on these survey results. Participants were asked to give their expert opinion on the progress of each of the 11 energy priorities (see page 8). The Index aggregates their answers by combining progress on each priority ("readiness") with an assessment of its importance ("system maturity", as measured by the average importance of all priorities, with a higher average pointing to a more systemic approach to the energy transition). The Index describes the perceived readiness, on a scale of 0 to 100%, of the energy transition toward net zero in the Middle East and Africa.

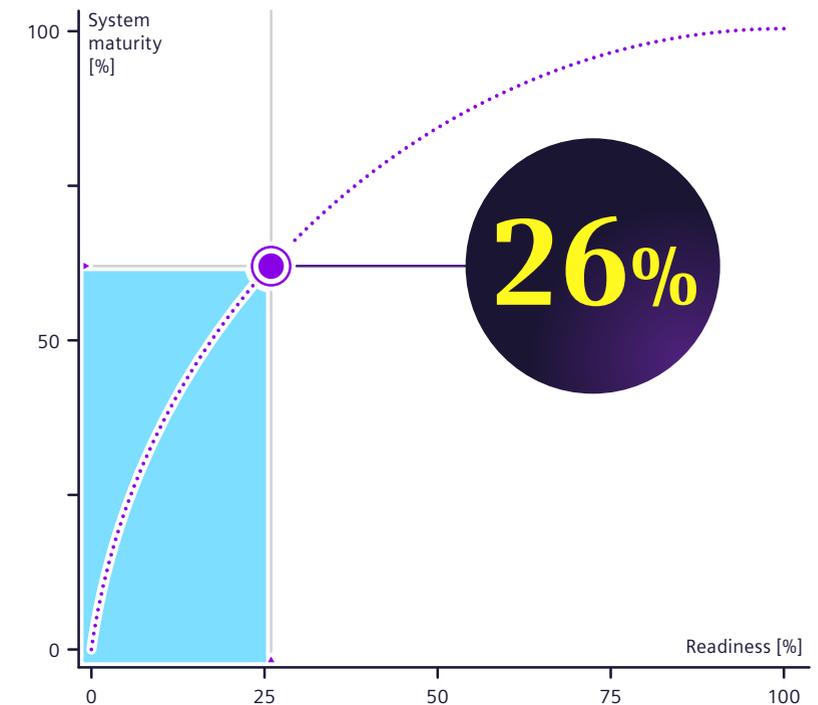
**"600 million people lack access to energy in Africa. With the continent's population doubling by 2050, energy is key to unlocking the future for the people."**

Nadja Haakansson, Managing Director Africa – Siemens Energy

The European energy crisis has strong implications for the Middle East and Africa. In particular, the war in Ukraine has resulted in a severe shortage of gas in mainland Europe. The European Union and national governments are currently pursuing a dual strategy aimed at mitigating the situation: On the one hand, they are attempting to speed up the energy transition, for example with the concrete actions laid out in the REPowerEU program; on the other, they are urgently pursuing alternative sources of gas imports. In both areas, the Middle East and Africa can be key partners as energy suppliers, as demonstrated by the visit of the German Economic Affairs Minister to various countries in the Middle East, soon after the conflict began, to discuss gas supplies and the export of green molecules.

The upcoming 2022 United Nations Climate Change Conference, or COP27, will take place in Africa, in Egypt. This gave particular relevance to discussions at the Energy Week about whether the global warming target of 1.5°C could be met – as we discuss in a special chapter dedicated to the COP27 below. Overall, the region scored 26% in the Energy Transition Readiness Index, which describes a region's perceived readiness with regard to the energy transition toward net zero (see the box).

While it is clear that the Middle East and Africa will not be able to cut their hydrocarbon dependency immediately, a heightened sense of urgency exists about speeding up the use of gas as a cleaner transition fuel and focusing on how to use greenhouse gas-emitting energy sources in the most efficient manner possible. It is vital that stable regulatory frameworks are established so that the region can realize its full potential as a global energy exporter, serving demand across the world.



# Green hydrogen in the Middle East and Africa

Hydrogen is an energy vector with huge potential for the region. The United Arab Emirates wants to have 25% of the global market share, and Saudi Arabia has announced plans to become the No. 1 hydrogen supplier globally. Green hydrogen is considered a “good fit” with the region’s capabilities, especially the countries’ broad potential in the area of renewables, their existing export infrastructure and their financing resources. Hydrogen also has the potential to decarbonize the region’s economies, which are currently strongly based on fossil fuels and have limited potential for electrification. Furthermore, it can diversify the heavy reliance on income from fossil fuels seen in countries such as Saudi Arabia, the United Arab Emirates and Oman.

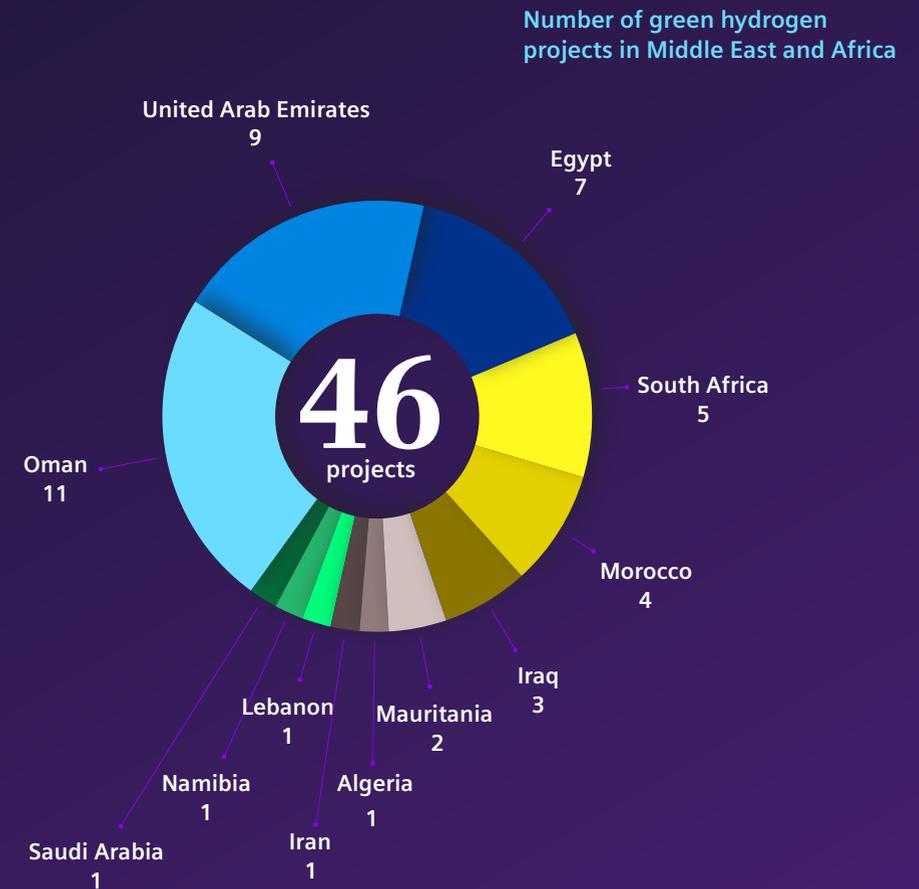
Key success factors for developing green hydrogen include the creation of hydrogen valleys (points of production linked to various points of consumption by means of shared, scaled-up infrastructure), the existence of clear regulations, access to key technologies such as electrolyzers, and the development of human capital.

Hydrogen can make a significant contribution to decarbonization. In the short term, it can be used in the form

of ammonia to avoid reconversion – here, technology is still under development. In the longer term, it can serve as an energy carrier, decarbonizing hard-to-abate sectors such as heavy-duty transportation and industries that use large amounts of thermal energy.

The development of green hydrogen is currently driven chiefly by hydrogen developers such as NEOM, ACWA Power, Masdar and OQ. These players are supported by the public sector, which is responsible for enabling factors such as hydrogen valleys, access to technology, clear regulation and the availability of human capital.

Key recent investments include the EXPO 2020 electrolyzer developed by DEWA and Siemens Energy, a small (1.25 MW) pilot. More than 40 investments of over USD 20 billion have also been announced in the region for the period to 2030. Current lighthouse projects include NEOM’s Helios project (2 GW of electrolyzer capacity, 4 GW of renewables and an investment of around USD 8 billion) and the joint 4 GW green hydrogen project in Egypt carried out by Masdar and Hassan Allam Utilities. The Green Energy Oman consortium is currently developing a 25 GW low carbon fuel project in Oman.



Source: Roland Berger, June 2022

“This year, many reports were issued. The most important of them is the IPCC report. All of them stressed that we are not on track to keep climate change below 2 degrees or even keep the 1.5°C target within reach. More work needs to be done.”

H.E. Mohamed Nasr, Ambassador, Director of the Environment and Sustainable Development department at the Ministry of Foreign Affairs of the Arab Republic of Egypt, Lead Negotiator for COP27

# CO<sub>2</sub> reduction: Despite the region’s prominent position, CO<sub>2</sub> reduction is by no means guaranteed

The Middle East and Africa make a relatively small contribution to global emissions: 7% of global CO<sub>2</sub> emissions stem from the Middle East and just 3% from Africa. However, the region suffers disproportionately from the consequences of climate change, as witnessed by the recent unprecedented heatwaves and increasingly frequent severe weather events.

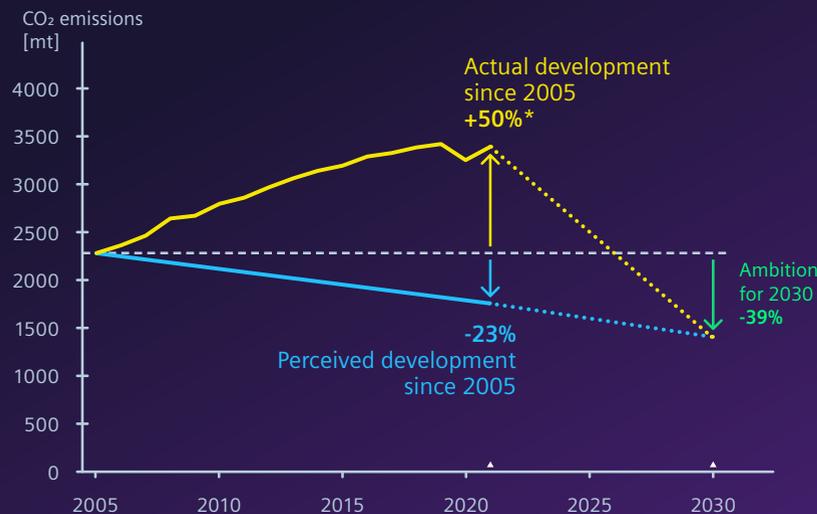
0.94 million tons of CO<sub>2</sub> per capita in Africa and 8 million tons per capita in the Middle East. This compares to 2.3 million tons per capita in South and Central America, 4.1 million in Asia Pacific, 5.6 million in Europe and 11.2 million in North America.

The Energy Week identified a significant gap between perceptions and reality when it comes to what has been achieved so far in cutting emissions. This same mismatch between perceptions and reality was also found in other regions. However, the Middle East and Africa stand out from other regions in terms of their prominent geographical position, infrastructure potential, willingness to change and the availability of investment capital.

## Ambitious targets for 2030

The gap between perceptions and reality filters through to participants’ expectations for the coming years, too. The survey of conference participants found that they were expecting emissions to fall to just 39% of their 2005 level by 2030. This is an extremely optimistic view given the little amount of progress achieved so far. Emissions need to fall in the region across the board – not just in the energy sector but in areas such as construction, industry and transportation. Conference participants agreed with academics that the 1.5°C target for maximum global warming is not achievable if we continue along the current path: Decarbonization efforts must be stepped up in order for the goal of carbon neutrality by 2050 to be realistic. In particular, the conference highlighted major opportunities in the large-scale export of green hydrogen as a potential way forward.

Conference participants on average estimated that the region’s emissions fell by 23% between 2005 and today, with only around one-third correctly stating that emissions have not fallen at all. In fact, emissions grew by around 50% between 2005 and 2021. In the Middle East, this increase was driven by heavy reliance on oil and gas and high standards of living. In Africa, the drivers include population growth, underdeveloped infrastructure and limited options for financing sustainable solutions. In 2021, emissions were

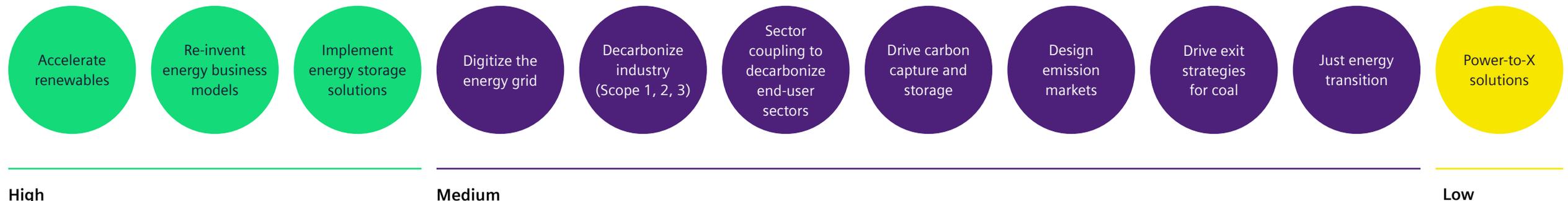


What is the level of CO<sub>2</sub> reduction in your country today and what will it be in 2030 compared to 2005?

\* Source: BP Statistical Review of World Energy July 2021

# Ranking the energy priorities

In the period to 2030, how strongly will each of the 11 energy priorities impact your achievement of climate targets? (Low impact = 1; medium impact = 2; high impact = 3)



## Identifying energy priorities

Global strategy consultancy and Energy Week partner Roland Berger identifies, in close collaboration with Siemens Energy, 11 priorities for tackling the energy transition. Successfully addressing these priorities on a global level will result in significant decarbonization and is likely to lead to net zero emissions.

Overall, conference participants – despite the diversity of their backgrounds and the evident differences between countries – considered all 11 priorities relatively important for achieving the energy transition goals. The factor with the greatest potential impact, they believe, is speeding up the expansion of renewable energy. This is an area where technology is already mature and implementation therefore relatively straightforward. In the Middle East, key economies have set ambitious targets for clean, renewable capacity. For example, Saudi Arabia is looking to scale up the share of gas and renewable energy in its energy mix to 50% respectively by 2030 and aiming for installed capacity of 59 GW by the same year. Similarly, the United Arab Emirates has set ambitious targets for 2050: to improve energy efficiency by 40%, reduce emissions from the power sector by 70% and increase the share of renewables in the energy mix to 44%.

The global push for decarbonization represents a threat to those economies in the Middle East and Africa that depend heavily on oil and gas exports. Unsurprisingly, therefore, participants consider reinventing the energy business a key priority. They also stress the im-

portance of implementing energy storage solutions, interconnecting transmission grids across national borders and devising a market design that incentivizes demand-side response – all factors that are key for enabling the flexibility of the energy system.

Surprisingly, given the region’s dependence on oil and gas, conference participants consider carbon capture, storage and use (CCUS) projects to be only a medium priority. Major players in the hydrocarbon industry have set ambitious targets for reducing emissions, while expanding their production capacity, by further deploying CCUS technology. For example, ADNOC plans to reduce its greenhouse gas emissions by 25% and expand its CCUS capacity to 5 million tons per year by 2030 – a fivefold increase compared to the current level. Similarly, Saudi Aramco has pledged to achieve a net zero target by 2050 for Scope 1 and 2 emissions, the first player in the region to do so. It is anticipated that CCUS technology will be commercially available by 2024 /2025.

# Current progress

Participants in the Energy Week report that progress on the energy priorities overall is fairly advanced. However, dedicated efforts are needed to achieve the 2030 climate targets. The most progress has been made on accelerating renewables and achieving a fair energy transition. Participants also perceive the decarbonization of industry to be advancing well. In the Middle East, exit strategies for coal generation are not applicable as very little coal is used; indeed, recently, the Dubai coal Hassyan project was converted into a gas-fired power plant. In Africa, by contrast, coal forms part of the energy mix and is an important pillar of the mining industry. Any phase-out must consider both of these aspects.

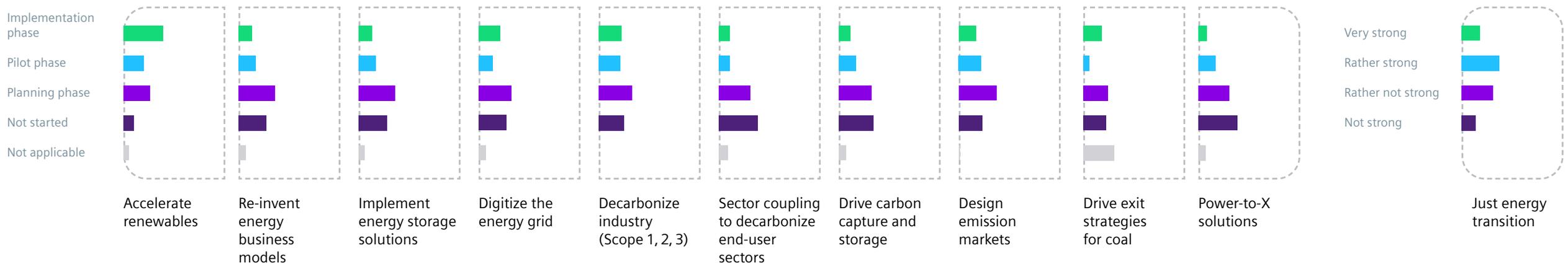
Progress on power-to-x solutions has been slow so far, evidently due to the novelty of the technology. Focusing on this area and the export of low-cost green hydrogen from the region is essential for the global decarbonization effort. Carbon capture and storage solutions will also be immensely helpful for the decarbonization of the hydrocarbon industry. In the Middle East, in particular, making headway with this priority could have a major impact on the energy transition.

“We need to accelerate the growth of energy in Africa, accelerate energy storage and innovation and build a regulatory framework where everyone is in sync.”

Khaled Sharbatly, Chief Executive Officer, Desert Technologies

“There is an asymmetrical distribution of wealth and capital between the countries in the north, which need a lot of these molecules to decarbonize their industries, and the countries more often in the south, which have a lot of the renewable energy resources.”

James Mnyupe, Presidential Economic Advisor – Government of the Republic of Namibia



What progress have you achieved on each of the energy priorities?

How strong is societal support for faster implementation?

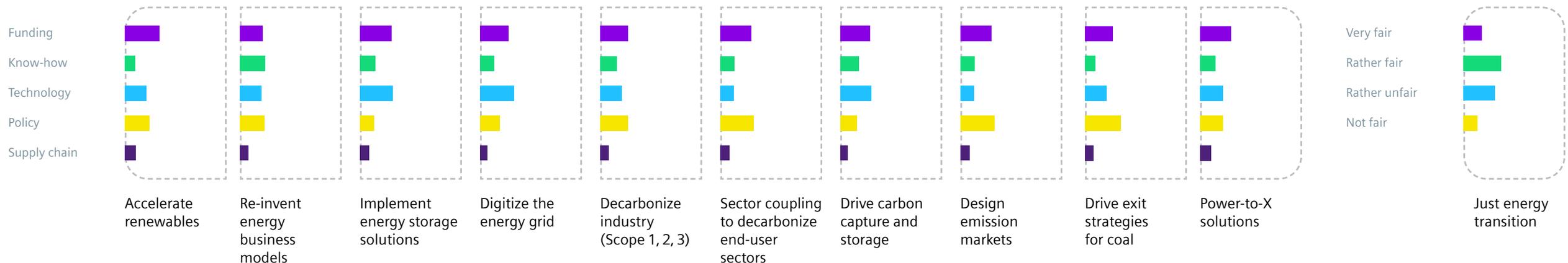
# What needs to be done?

According to the conference participants, three key areas where action is needed are: policy, funding and technological innovation. The success of the energy transition hinges on the existence of a clear, stable policy framework. Business and financial institutions need this solid basis on which to make their long-term and often irreversible investment decisions. Building the required infrastructure for decarbonizing society also requires funding that is front-loaded at the development stage of projects. In the current low-interest environment, funding is readily available in the Middle East, especially for renewable energy projects.

Technological hurdles exist for emerging technologies such as carbon capture and storage and long-term energy storage. At the moment, technology is not commercially available on the scale required to facilitate the energy transition. Know-how is also critical for emerging technologies such as long-term energy storage, power-to-X and sector coupling. In addition, participants report that knowledge is lacking in the area of reinventing energy business models.

“Transitioning to hydrogen requires huge investment to develop technology, build projects and establish marketplaces that collectively contribute to a cleaner energy future. This coordinated effort by all stakeholders must be supported by policymakers to achieve success.”

Nabil Nuaim, Chief Digital Officer  
Saudi Aramco



What is most needed for the future development of each energy priority?

How fair is the energy transition in terms of jobs, access and affordability?

## Policy support

The successful decarbonization of the Middle East and Africa will require a strong policy-led approach. This should tackle two priority areas: current high energy subsidies for utilities, and overconsumption of carbon-based fuels by end customers. However, policymakers also need to provide clarity on their regulation, e.g. how “green” hydrogen is defined in import markets like the EU.

Decarbonization and energy efficiency have driven major recent shifts in regional policies, such as the partial removal of the energy subsidies that have kept energy and water rates below economic cost for decades. Reducing subsidies both lessens the financial burden on governments and encourages consumers to use resources more efficiently. As a result, the pace slows at which new capacity needs to be added. For example, the United Arab Emirates has implemented gradual reforms to its fuel, water and electricity subsidies. These steps have been effective, but further action is now needed to reduce overall consumption without negatively impacting the competitiveness of the economy. Most pressing are policy reforms that are needed in decentral power generation, electric vehicles and carbon markets.

Introducing carbon pricing will be a key future policy pillar. Saudi Arabia and the United Arab Emirates are already considering establishing carbon markets. With COP27 taking place in Egypt and COP28 in the United Arab Emirates, policy development is expected to speed up, with key regional governments looking to claim the first carbon market in the Gulf Cooperation Council (GCC). Regional governments are also hoping to develop policies that encourage the expansion and boost the competitiveness of local green hydrogen ecosystems.

## Investment in renewables

Worldwide installed capacity in renewable energy would need to quadruple in order to limit global warming to 1.5°C. For the Middle East and Africa, this means that installed capacity would have to grow to 1 TW by 2030 – a thirteen-fold increase from current levels – and 3.5 TW by 2050. Such growth represents an enormous challenge compared to other regions (see figure below). Reaching this ambitious target will require investments of USD 670 billion by 2030 (USD 350 billion for wind and USD 320 billion for solar) and a total of USD 3.4 trillion by 2050. On the positive side, the Middle East and Africa enjoy favorable conditions for wind and solar power, with more than 60% of total energy demand located in regions with high wind and solar potential. Making the required investments could potentially create around 1.5 million jobs across the region.

The Middle East has consistently been breaking records for the lowest levelized cost of electricity (LCOE) in the world for photovoltaic plants. Notable projects include the 2 GW Al-Dhafra solar PV IPP in Abu Dhabi, which has an LCOE of USD 1.35 cents/kWh, and the 600 MW Al-Faisaliah solar PV IPP in Saudi Arabia, with an LCOE of USD 1.04 cents/kWh.

Required renewable energy generation capacity (TW) in MEA to maintain 1.5° goal and required investment



Source: IRENA – World Energy Transition Outlook (2022)



How strong is societal support for faster implementation in Africa?



What is preventing Africa from achieving sustainable energy?

# UN Climate Conference in Egypt

## The 1.5°C target

To achieve the target of limiting global warming to 1.5°C, global net greenhouse gas emissions need to fall by 43% by 2030 and 84% by 2040 compared to 2019 levels, according to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). Emissions must peak at the latest by 2025, and net zero CO<sub>2</sub> emissions must be achieved some time in the 2050s. If current trends continue, however, the increase by the end of the century will be 2.6°C. With this in mind, governments in the region have announced strategies that should limit this increase to between 1.8°C and 2.4°C. It is expected that more ambitious targets will be introduced in the coming years.

The government of Egypt identified three main areas to guide the discussion at COP 27:

- **Mitigation:** Fostering unity behind the 1.5°C goal – “This year should witness the implementation of the Glasgow pact call to review ambition in NDCs, and create a work program for ambition on mitigation”
- **Adaptation:** Manage extreme weather events and the resulting impact on human life – “COP27 should witness enhanced global agenda for action on adaptation, confirming what we agreed on in Paris and further elaborated in Glasgow pact with regard to placing adaptation at the forefront of global action”
- **Finance:** Achieve progress on crucial issues of climate finance – “Progress on delivery of the annual USD 100 billion will build more trust between developed and developing countries, showing that actual commitments are being fulfilled”

At COP27, the role of corporations will be particularly important due to the limited action that has so far been taken by governments. Having said that, globally only 10% to 15% of large corporations have set a target of at least 50% emission reductions by 2030. This trend will accelerate as sustainability becomes a competitive advantage.

To utilize this competitive edge, businesses can take a number of steps. One key priority is achieving energy decarbonization, which must include securing access to green energy. Companies can consider a three-pronged approach here: reducing consumption, producing green electricity and switching to low-carbon alternatives. Companies can also focus on product design and circularity, limiting their products’ carbon footprint and rethinking their design and material mix or increasing circularity. Another potential step for businesses is climate digitalization, a process in which companies track their progress and optimize their decarbonization pathway with the help of digital tools and artificial intelligence.

“COP27, followed by COP28 in the UAE, should focus on unifying Africa, the West and the East, the North and the South.

Francesco La Camera,  
Director General, IRENA

# Energy priorities in detail

## Drive exit strategies for coal

Decarbonization requires a step-by-step phaseout of power and heat generation from coal. Strategies must manage this while simultaneously ensuring a secure supply of power and heat. Coal's role in the transition to carbon neutrality must be clearly defined within these strategies.

## Accelerate renewables

The speed of the expansion of renewable energy is strongly linked to the speed of decarbonization. However, technological, societal and bureaucratic barriers partly impede progress. Lifting these barriers is key to speeding up the rollout of renewable energy solutions.

## Drive carbon capture and storage

Carbon capture and storage (CCS) is a technological solution for capturing emissions and storing carbon in a way that lessens its climate impact. Decarbonization strategies must define the role of CCS technologies in the transition toward climate neutrality.

## Digitize the energy grid

A greater share of intermittent renewable energies makes it more challenging for power grids to maintain a secure power supply. The safe and reliable set-up, maintenance and operation of the future energy grid require new digital solutions.

## Implement energy storage solutions

The intermittency of renewables necessitates both short-term and long-term energy storage solutions. Technological and economic solutions must be devised to ensure that 100-percent renewable energy delivers a highly secure supply.

## Power-to-X solutions

The transformation of power to hydrogen and other fuels enables the storage of otherwise curtailed renewable energy. Additionally, power-to-X fuels can be used in hard-to-abate sectors such as aviation and shipping or high-temperature industrial processes.

## Decarbonize industry (Scope 1, 2, 3)

Industrial production can generate significant carbon emissions. These must be reduced across Scopes 1, 2 and 3 in order to move toward a carbon-neutral industry and society. The rollout of new production processes and energy-efficiency measures must define a pathway to carbon neutrality.

## Sector coupling to decarbonize end-user sectors

All energy end-user sectors must be decarbonized to create a truly climate-neutral society. With an increased share of renewable power generation, the heating and mobility sectors can be decarbonized via the electrification of end-user appliances.

## Re-invent energy business models

Energy business models are a key enabler for fostering investment in decarbonization technology, for example, via contracting solutions. Solutions such as PPAs (power purchase agreements) and long-term trading can secure payment streams over the investment period, which makes investments bankable and suitable for low-interest financing.

## Design emission markets

An overarching regulatory framework must ensure the cost-efficient reduction of carbon emissions wherever possible. Implementation of emission markets and/or carbon pricing mechanisms is crucial in order to align incentives across continents, countries and sectors.

## Just energy transition

Social acceptance is an essential component of the energy transition. A fair energy transition further facilitates affordable energy supply, decent working conditions, as well as diversity and inclusion. Social distortions must be avoided, as well as energy poverty and resistance to renewable energy.



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